FARM WOODLANDS IN THE CORN BELT REGION OF ILLINOIS

by

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SUMMARY

A study of sample farm woodlands in the corn belt region of Illinois showed that they are growing far less timber than they could if properly handled. Heavy past cutting on forest land capable of producing high-grade hardwood timber has seriously reduced the forest growing stock. Less than 5 percent of the area supported heavy saw-timber stands, 32 percent light saw timber, and the remaining area bore stands below saw-timber size. Fully one-third of the stand was cull material. Eighty percent of the available sawlogs were of grade 3 quality. Although the average diameter growth of trees was fair, the average saw-timber growth per acre was low, indicating that there were not enough good trees per acre to furnish a base for good growth. The harvest of forest products was largely for fuelwood, with some rough lumber and fence posts. Very little was sold for the manufacture of high-value wood products, probably because the high-grade material was too scattered to permit economic harvesting and marketing.

The question of how to manage corn belt forest lands hinges first on a decision by the owner whether to keep the land in forest or convert to another use. If forests are to be retained, the owner should manage them for high production of quality material. The demand for fuelwood and posts should be met by cutting cull trees and thinning dense pole stands. The stocking of the depleted stands should be increased. Some planting may be necessary. Woodlands should be protected from grazing damage. The owner should secure available technical assistance of the local District Forester or Extension Forester in managing his woodland.

1/ Based on a study by Robert E. Worthington and Burt P. Kirkland, both formerly of the U. S. Forest Service, the results of which are incorporated in a manuscript "The Function of Woodlands in Corn Belt Farming". Field work was done under a cooperative agreement between the Central States Forest Experiment Station and the Forestry Department, University of Illinois Agricultural Experiment Station.

THE PROBLEM

The shortage of wood products throughout the country during and following World War II was especially critical in areas far removed from principal sources of supply. Such an area is the corn belt region of northern Illinois. Its many industries and intensive agriculture normally consume large quantities of wood products, most of which are shipped long distances and are very costly. This region contains, in the aggregate, a substantial acreage of forest land--not nearly enough to produce timber for all its needs but enough to make a substantial contribution. During recent decades, the harvest of forest products in the corn belt region has been low, both in quantity and quality. The principal reason for this is the poor quality of the existing stands. One of the reasons why these stands are of poor quality is that farmers lack information on the value of woodland yields. Because of this lack, it was decided to release at this time data gathered before the war but unpublished because of wartime restrictions.

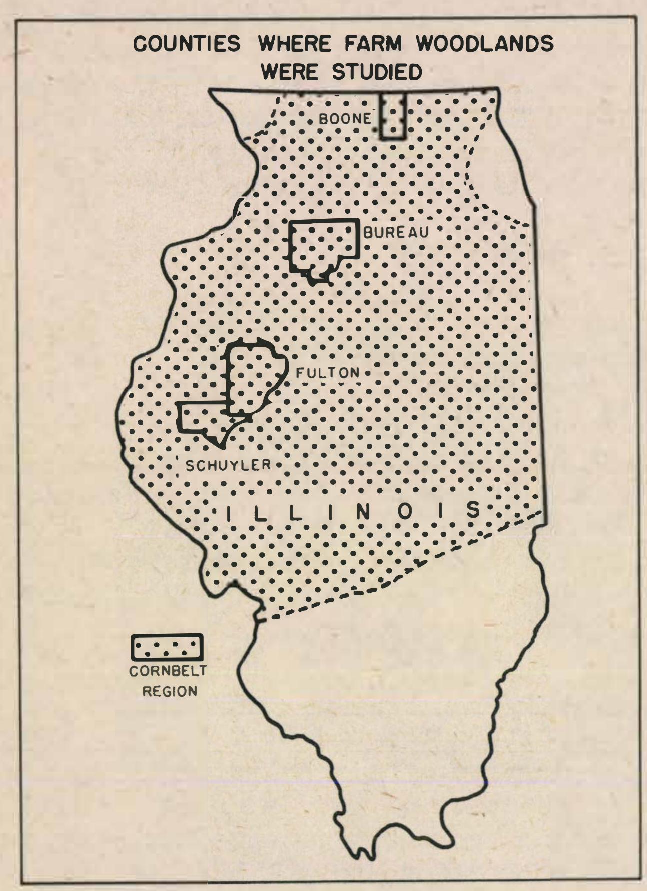

Fig. 1

To provide some information on the condition and yield of farm woodlands, a systematic study in northern Illinois was initiated in 1939. Eighty farms in four representative counties (Boone, Bureau, Fulton, and Schuyler) were chosen for intensive investigation of woodland farms. To qualify as a sample farm, each farm chosen had to contain at least 60 acres of which 5 acres or more were woodland. Farms were chosen at random from Agricultural Adjustment Administration township lists until 80 such farms were selected. Field crews visited each farm, collecting data on area, composition, and condition of timber stands; quantity, quality and farm production and consumption

of forest products. Some of the information thus gathered is presented in this report.

THE REGION AND ITS WOODLANDS

The corn belt region of Illinois includes most of the northern two-thirds of the state - from the Wisconsin boundary south approximately to U. S. Route 40. (See Figure 1). It is an undulating to gently rolling agricultural country dissected by several locally important river systems. Corn, other grains, forage, and livestock are the principal farm products.

Prior to settlement, the area was principally prairie with scattered stands of hardwood. With settlement much of the forest land was cleared for agriculture. Scattered patches of forest were left along stream bottoms, on the poorer sites, and even on some good cropland. Probably less than 10 percent of the region's area is now in woodland of all kinds. Most of the farms have some trees, varying from groups which serve shade and windbreak purposes to woodlots of several acres, and in some cases to stands of more than one hundred acres.

These scattered patches are allowed to remain in forest cover for a variety of reasons, most of which are not connected with direct cash income. The farm operator may have a woodlot for a reliable source of posts and fuelwood; his land may need protection from erosion; he may be satisfied with his present tillable acreage; he may feel that the effort and expense of clearing forest land is not justified; or he may keep his woodlot simply for the pleasure he gets from having the trees on his farm. For these and other reasons the woodland area of the region is not being noticeably decreased although considerable cutting is being done.

All of the woodlands encountered in the study were hardwoods of natural origin. There were no coniferous stands and there was no evidence of planting. All had been at least partially cut over so that no examples of virgin forest remained. Usually about half of the stocking was in various species of oaks, the remainder in elms, maples, hickories, walnut, basswood, cottonwood, and others.

STAND CONDITIONS

In the study, woodlands were divided into seven stand-condition classes chiefly on the basis of the number of trees of different sizes present. These classes--definitions and relative areas of which are shown in Figure 2--ranged from heavy saw-timber--heavy pole stands with fairly dense forest cover to seedling and sapling

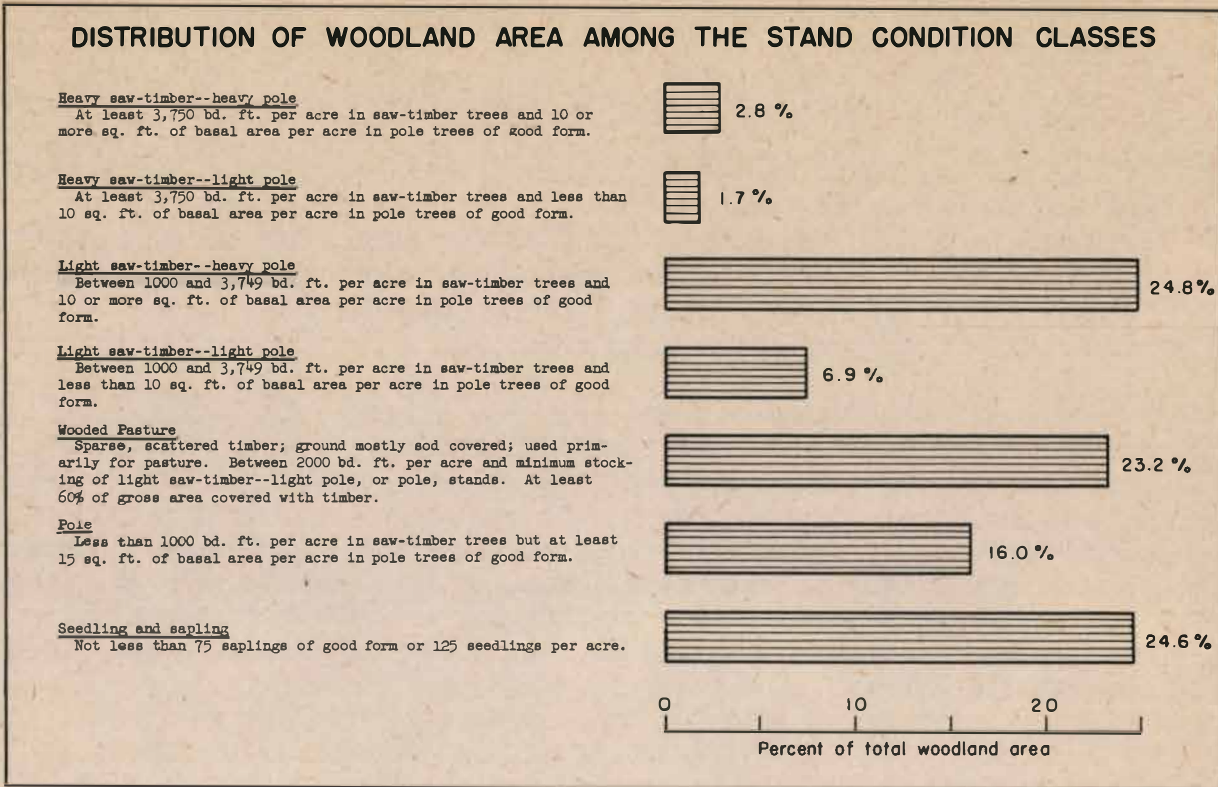

Fig. 2

stands in which new growth was just getting underway. 2/

Areas of Stand-Condition Classes

Figure 2 shows that less than one-twentieth of the total woodland area is in heavy saw timber. Even this has been lightly cut but leaving, however, a considerable number of saw-timber trees per acre. Such stands are the best that the region now affords, but their small area makes them relatively unimportant. The light saw-timber--heavy pole stands, which occupy one-fourth of the area, contain most of the remaining saw timber. Another one-fourth of the area falls in the wooded pasture class, where the primary use of the land is for grazing livestock. Still another one-fourth supports the seedling and sapling stands, and about one-sixth bears pole stands.

2/ Saw-timber trees are those 13.0 in. and more in diam. at breast ht.
Pole trees are those 5.0 in. to 12.9 in. " " " " "
Sapling trees are those 1.0 in. to 4.9 in. " " " " "
Seedling trees are those 2 ft. in ht. to 0.9 in. " " " "

Stocking and Volume

Figure 3 shows stocking and volume 3/ information for each of the stand-condition classes. Individual trees were classified as "good", "sound cull", and "rotten cull", according to their present or potential suitability for sawlog material. 4/

In comparison with well-stocked all-age stands, the farm woodlands studied are, in general, understocked. The small area in heavy saw-timber stands, however, shows reasonably good stocking. In spite of the fact that 30 percent of the basal area 5/ is in culls, there are 25 to 27 good saw-timber trees per acre, and the average volume per acre is slightly more than 4,000 board feet. All of the other stands, which amount to more than 95 percent of the area, are below the stocking usually recommended for all-age forests. From the heavy saw-timber stands down, volume and basal area decline. Seventy percent of the woodland area averages less than 54 sq. ft. of basal area per acre in saw-timber and pole trees. A well-stocked all-age stand might average almost twice this.

Thirty-seven percent of the basal area of the entire sampled woodland was classed as cull. The proportion is high (28 percent) even in the heavy saw-timber--heavy pole stands but in the wooded pasture and seedling and sapling stands, about half of the basal area is in this classification.

Not only is the stocking of trees of saw timber and pole sizes generally poor, but the oncoming crop of seedlings and saplings shows

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3/ Board-foot volumes based on International (1/4 in. kerf) log rule with deductions for woods and mill cull. Minimum top diameter for sawlogs was 10 in. Cubic-foot volumes apply to portion of trees between stump and 3 in. limit on stem and limbs.

4/ A good tree contains, or gives promise of producing, at least one usable 12-ft. sawlog. At least one-half of the stem must be sound.

A sound cull neither contains, nor gives promise of producing a usable 12-ft. sawlog because of poor form, large or numerous limbs, sweep, or other sound defect.

A rotten cull is a tree more than 13 in. d.b.h. with 24 ft. or less of sawlog stem which, due to rot, does not contain a usable 12-ft. sawlog; or a tree of unusual size and value which will not yield one-half of its gross scale in usable logs; or a pole tree having less than one-half of its stem sound.

5/ The total area, usually expressed in square feet, of the cross-section at breast height of a group of trees.

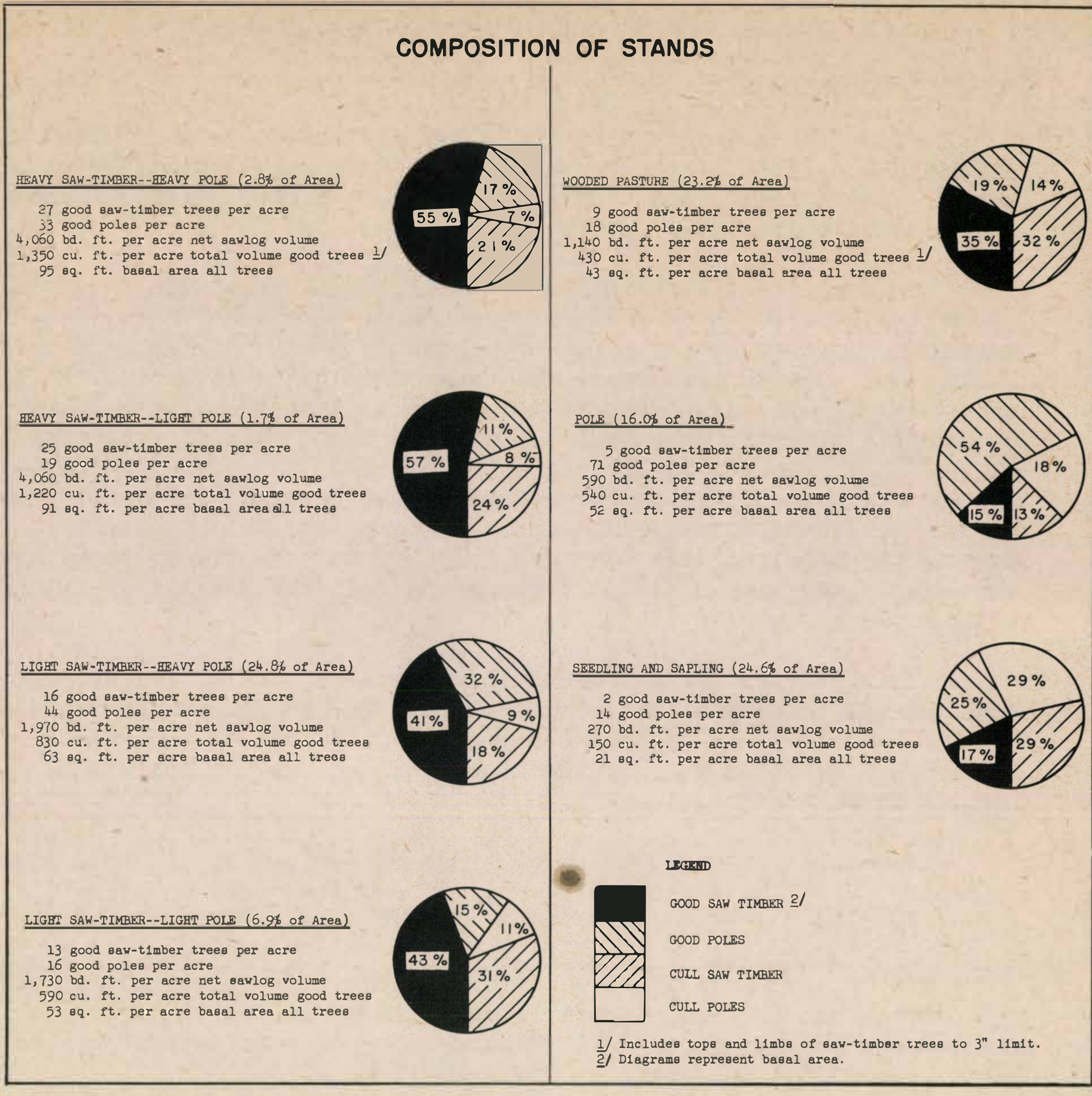

Fig. 3

little likelihood of remedying this situation. More than 1200 randomly-spaced 1/100 acre plots were examined for the presence of saplings. Sixty-five percent of these plots showed no saplings. Similarly, more than 5000 1/400 acre plots were examined for the presence of seedlings. Sixty-four percent of these contained no seedlings.

Log Quality

The overall picture of log quality of the good trees in the stands was found to be 14 percent grade 1, 6 percent grade 2, and

80 percent grade 3. 6/ Grade 1 logs are suitable for making high-grade lumber, veneer and other high-quality products; grade 2 is suited for cooperage stock, handle stock, and small dimension; and grade 3 logs can be made into rough lumber, fence posts, or cross-ties. The specifications for grades one and two were not particularly high, yet four-fifths of the log volume was in grade 3 logs. This suggests that past cutting has been chiefly concentrated in the best trees in the stands.

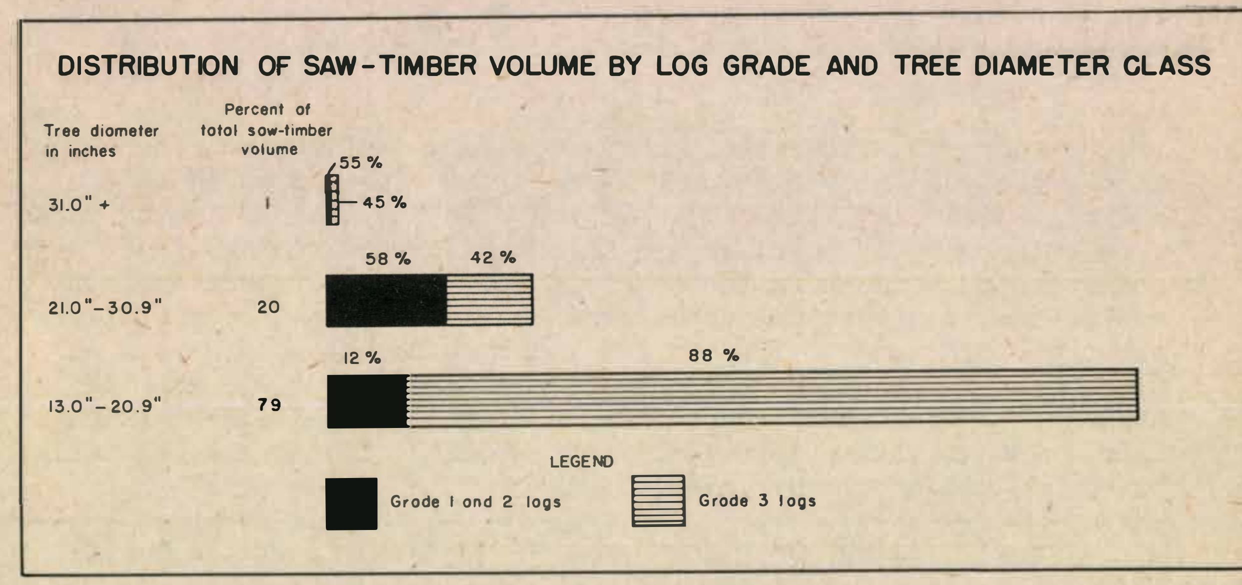

Fig. 4

Figure 4 shows the distribution of log grades by tree diameter classes. Only 12 percent of the log volume of small saw-timber trees (13.0 - 20.9 in.) could be classed as grade 1 and 2 logs while more than 50 percent of the volume of the larger trees was grade 1 and 2. Thus, while good saw-timber trees 21.0 in. d.b.h. and larger make up only 21 percent of the total saw-timber volume of the woodlands, these trees contain about 55 percent of all the grade 1 and 2 logs available. This condition is evidence of the much greater relative value of the larger trees.

6/ Grade 1 - length 12 ft. or more, top diameter 14.0 in. or more (12.0 in. for ash, cherry, and walnut). 60 percent of surface absolutely clear, in sections 4 ft. long. Gives promise of cutting 25 percent of gross scale in lumber of grades No. 1 common and better. Grade 2 - length 8 ft. or more, top diameter same as grade 1. More than 1/2 of length in straight, clear sections at least 30 in. long. Grade 3 - minimum length 8 ft., minimum top diameter 10 in. Sound and straight enough for practicable handling. Gives promise of yielding at least one-half of gross scale in sound boards.

Growth

Average saw-timber growth per acre in the heavy saw-timber stands may be considered fair for the forest type and the region. Figure 5 shows that these stands have an annual saw-timber increment of 142-165 board feet per acre, without subtracting mortality. Growth in all other stand-condition classes is less. The average for all stands is 76 board feet per acre per year. Growth in each stand is in rough proportion to its basal area. Most of the area does not contain enough good trees to furnish a base for good growth.

Ingrowth - the total board-foot volume of those trees which in any one year grow from pole size to saw-timber size (13.0 in. and up) - is relatively high. Ingrowth in the stands studied ranged from 32 percent of total growth in the heavy saw-timber--light pole stands to 82 percent in the pole stands. These extremes are not surprising, considering the difference in board-foot volume of the two types of stands. The average ingrowth for all stands was 62 percent of the total board-foot volume increment. This is much higher than would be found in stands of more normal age distribution. Too great a proportion of the growth is being made by small trees and not enough by large trees.

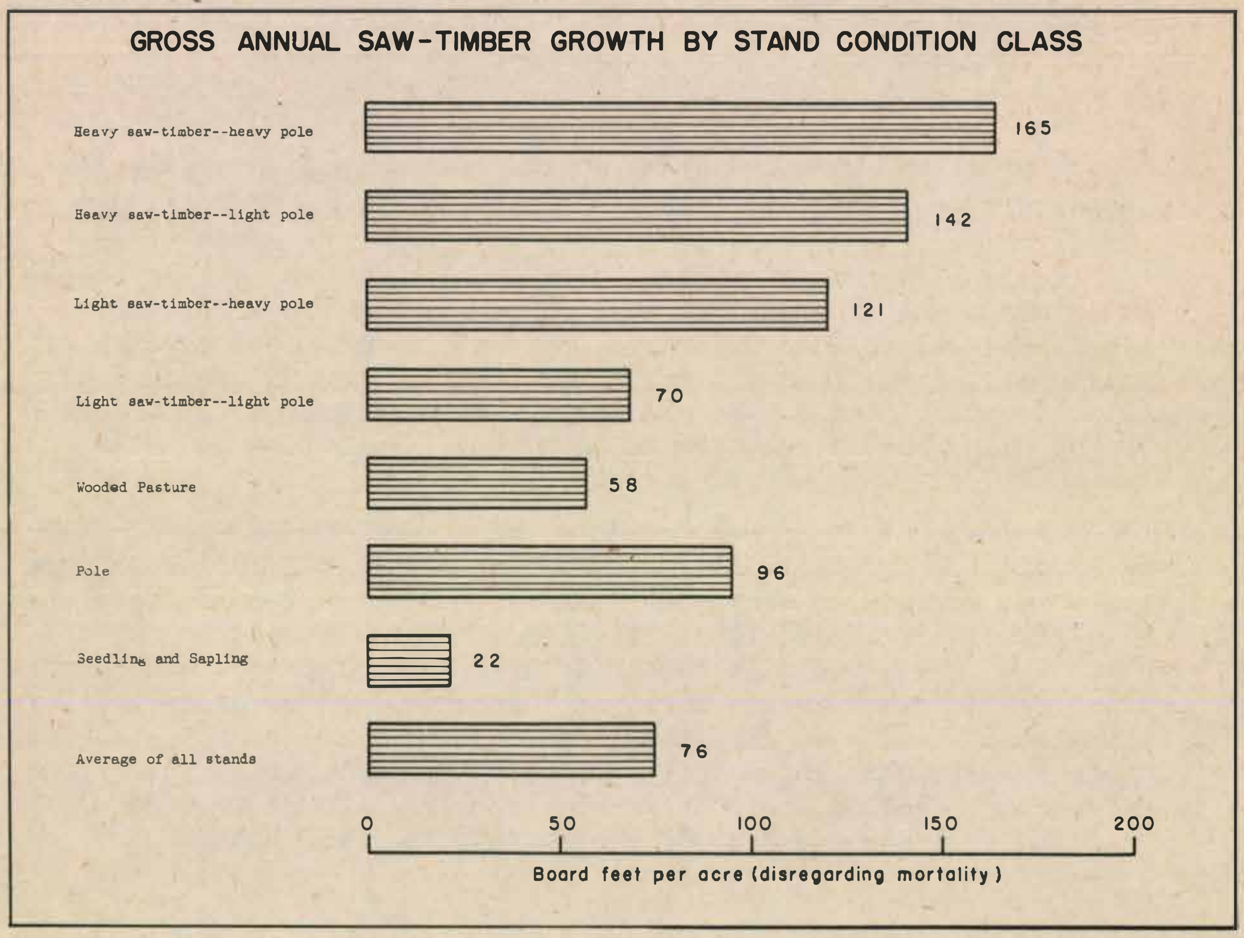

Fig. 5

Table 1 indicates that the diameter growth of individual trees is average or better. A ten-year diameter increase of 1.74 in. for hard maple compares favorably with growth after logging as measured in studies in the Lake States.7/

Table 1. - Average Diameter Growth by Species 1/

Species	Increase in 10 Years
	Inches
Fast-growing species	
Cottonwood	3.57
American Elm	2.18
Slippery Elm	2.13
Basswood	2.11
Species of moderate growth	
Walnut	1.94
Red Oak	1.79
Black Oak	1.79
Hard Maple	1.74
Slow-growing species	
White Oak	1.57
Burr Oak	1.46
Better Hickories	1.32

1/ Measured on dominant and co-dominant trees only.

Diameter growth is not dependent upon tree diameter. Within each species the smaller trees increased in diameter at about the same rate as the larger trees, but species differ significantly in growth rates. Species which occur on moister sites grow more rapidly in diameter than species which are found on the ridges. For example, cottonwood grows in diameter almost three times as fast as hickory. Species which are found in both locations, such as elm, grow faster in the bottomlands than they do in the uplands.

The growth rate of trees, independent of species, is linked with the size of their crowns and their relative dominance in the stands. Trees with high, well-developed tops put on much more diameter growth than those with small crown areas. Table 2 shows this disparity and also the interesting point that the few large trees in

7/ Zon, Raphael, and Scholtz, H. F., How fast do northern hardwoods grow? Agricultural Experiment Station of the University of Wisconsin, Research Bulletin 88, 1929, 34 pp.Illus.

wooded pasture, pole, and seedling and sapling stands increased in diameter more rapidly than did the large trees in saw-timber stands. This is probably due to the greater competition in the saw-timber stands.

Table 2. - Average Diameter Growth by Crown Class

Stand-Condition Class	Increase in 10 Years: Dominant and Co-dominant Trees	Increase in 10 Years: Intermediate and Suppressed Trees
	Inches	Inches
Saw-timber stands	1.65	1.13
Wooded pasture	1.81	1.24
Pole and Seedling and Sapling stands	1.77	1.20

Since volume growth per acre is low but diameter growth of individual trees is average or better, the logical conclusion is that poor stocking is the principal cause of poor volume growth.

HARVEST AND USE

Timber Harvested

The principal products of the sampled woodlands, were (1) fuelwood, (2) fence posts, and (3) lumber.

Operators of woodland farms cut annually about 8 1/2 standard cords of fuelwood per farm, using most of it on the home farm in heating stoves. Very little of it was sold.

About 93 fence posts per farm were cut each year from the farm woodlands. In addition, some posts were bought. Half of the posts bought were of eastern red cedar which had to be shipped into the region; the rest were of local species. Post cutting for sale was not an important activity, most operators cutting only enough to partially supply their own demands.

About 1,300 board feet of rough lumber per year were cut from the average woodland farm. Many small sawmills are located throughout the region, doing custom sawing as well as producing lumber for the open market. Most of the rough lumber used on the farms was cut from logs grown on the property. Log sales and stumpage sales were very rare.

Most of the cutting was done to supply farm needs. Only in the case of rough lumber did sales amount to a considerable part of the total production. Figures for disposition of the products from

the average farm are as follows:

	Cut and Used	Cut and Sold
Fuelwood	8.43 cords	0.07 cords
Fence posts	82. posts	11. posts
Lumber	.4 M bd. ft.	.9 M bd. ft.

These volumes actually removed from the farm woodlands are difficult to compare unless they are expressed in a common unit of measure. To that end, we can convert them all to cubic feet of round wood, 8/ with the following results:

Fuelwood	612 cu. ft. per farm	71 percent of volume
Fence posts	70 cu. ft. per farm	8 percent of volume
Lumber	186 cu. ft. per farm	21 percent of volume

From the above it appears that more than 70 percent of the total volume cut from these woods was consumed as fuelwood by the farmers themselves. If we assume that farmers used or sold their wood so as to bring them the highest return, there are three principal explanations for the large percentage of fuelwood cut: (1) there was low demand for other products, or (2) there was not enough high-quality material to encourage harvest and utilization for better products, and (3) high-quality material was not sufficiently concentrated to permit economic utilization.

The Value of the Harvest

On the sampled woodland farms, the value of forest products for the year 1938 was $101.02 per farm, or $2.73 per acre gross income. This is the farm value of the products and includes the costs of cutting, skidding and sawing as well as the stumpage price. This value is probably typical of a normal pre-war year. Fuelwood at that time was worth $4.00 a cord on the farm, fence posts were $.30 each, and rough lumber brought $30.00 per thousand board feet. By 1947, prices had about doubled so that farmers investing the same amounts of labor and managerial skill in their woodland harvest could expect to realize about $5.50 per acre gross income. It should be understood that this income was obtained from the cut of a single year. Furthermore, we do not know if the woodlands involved are capable of sustaining as great a cut.

8/ Conversion factors: 1 cord = 72 cu. ft. of solid peeled wood.
1 post = 3/4 cu. ft.
1 cu. ft. = 7 bd. ft.

Volumes and values of the 1938 cut were as follows:

Kind of Material	Unit	Amount	Farm Value
		Total Material Cut	
Fuelwood	cords per farm	8.50	$34.00
Fence posts	posts per farm	93.	28.02
Lumber	M bd. ft. per farm	1.3	39.00
			$101.02

When these volumes are converted through cubic feet to percentages, some comparisons of volume and value can be made. (See Figure 6). Although fuelwood was 71 percent of the volume of the products, its value was only 34 percent of total value. Posts, on the other hand, contributed 28 percent of the income but were only 8 percent of the volume. Another way of stating this is that:

Fuelwood sold for	5 1/2 cents per cu. ft.
Lumber sold for	21 cents per cu. ft. of round wood
Fence posts sold for	40 cents per cu. ft.

which demonstrates the low return for fuelwood, the high return for fence posts, and emphasizes the relatively low value of the lumber produced.

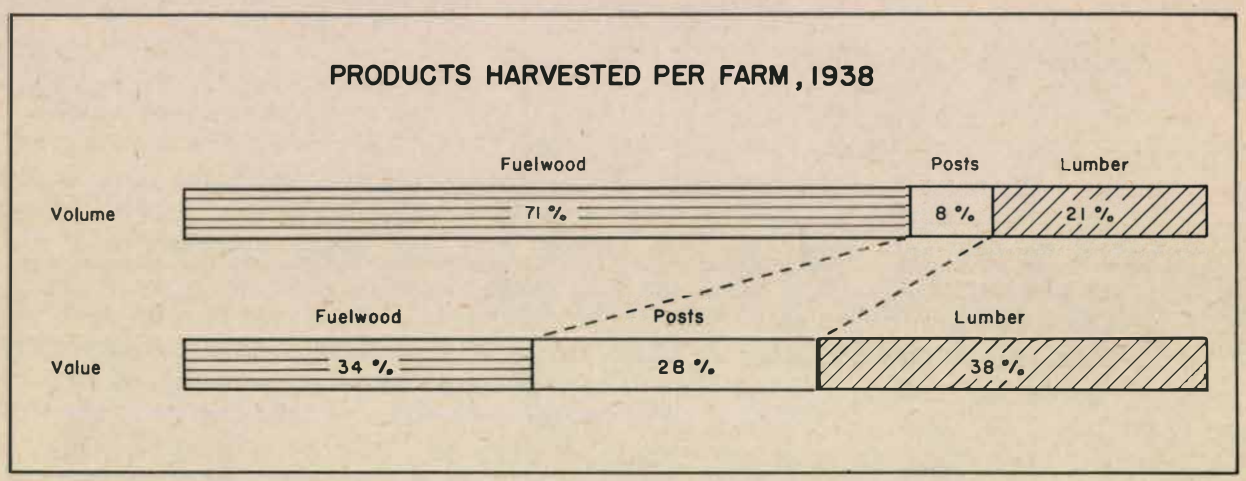

Fig. 6

Grazing in the Woodlands

Eighty-one percent of the woodland area of the sample farms was grazed by domestic livestock in 1939. The study did not determine the extent to which grazing was responsible for the depleted condition of the woodlands, but it is generally conceded that grazing, as practiced in the corn belt, contributes materially to the deterioration of the stands. Apart from the damage thus caused to growing stock and

site, grazing woodlands is reported to be inefficient from the standpoint of animal maintenance and growth. 9/ The volume of forage available in the woodlands was found to be far less than that available in various types of open pasture. 10/ More recent studies in other states have indicated that the nutritive value of woodland forage in the corn belt is less than that of good pasture grass, 9/ so the measurement of forage volume alone does not adequately show the low value of woodland pasture. Efforts to rebuild the depleted forest resource should necessarily include protection from the damage caused by grazing.

Summarizing the main points in harvest and use, timber was taken from the farm woods mostly for farm use, not for sale. Seventy-one percent of the volume went into fuelwood. Fence posts, which were only 8 percent of the volume, contributed 28 percent of the total value. Fence posts were twice as valuable, per unit volume, as rough lumber. Eighty-one percent of the woodlands were used for livestock pasture.

DISCUSSION AND CONCLUSIONS

Basic Decision Needed

The poor conditions prevalent in the corn belt woodlands just described are the result of mismanagement. Over-cutting has reduced volume and stocking to a point where less than 5 percent of the area can be called heavy saw timber and only 36 percent saw timber of all classes. Heavy cutting of the best trees of largest size (high grading) has skimmed the cream of the forest crop so that now 37 percent of the total basal area is in cull trees and 80 percent of the available sawlogs are of third-rate quality. His woodland having arrived at this state of affairs, the average owner is doing little or nothing about it. In most cases he has no plan in operation for making the wooded areas truly productive.

In the interests of both community and individual welfare, these semi-idle lands should be put to work. Each owner should decide, in the light of the best information available, whether to keep his land in forest or to convert it to pasture or cropland.

9/ DenUyl, Daniel, and Day, Ralph K., Woodland livestock carrying capacities and grazing injury studies., Purdue University Agricultural Experiment Station, Bulletin No. 391 Revised, 1939, 16 pp. Illus.

10/ James Talbott and Elvin A. Duerst, graduate agriculturists, developed the method and performed the work of pasture productivity evaluation. They were assisted by Dr. Robert A. Fuellemann, Department of Agronomy, University of Illinois Agricultural Experiment Station.

Having made this decision, he should manage it accordingly. In some cases, the decision may logically be for conversion to a use other than forest. On some areas, forest deterioration is so far advanced that conversion to pasture is already practically accomplished. If the owner's decision is to keep the area in woods, the application of proper silviculture for each site and stand condition will generally pay dividends. The woods can be made to pay. To this end they should be as carefully managed as any other agricultural crop. For the management of the two principal kinds of corn belt forests (bottomland and upland), the following procedures are suggested.

Stands of cottonwood and willow, with a mixture of elm, sycamore, soft maple, and other species, occupy the banks and flood plains of most of the region's streams. Because of the soft fibers, rapid early growth, and ease of reproduction of these species, it has been suggested that clearcutting on a 15-20 year rotation for pulpwood is the most desirable method of management. This method has its advantages. It is relatively simple and requires little technical skill to obtain results. Also, there is at present an expanding market for pulpwood to use in the local feltwood industry. However, with cottonwood logs currently selling for $30 per M delivered, it is by no means certain that management for pulpwood exclusively is the best plan. The owner might make more money by allowing the best trees to reach sawlog size, harvesting only thinnings for pulpwood. Studies are needed to answer this question.

Bottomland stands which are to be clearcut periodically would require a minimum of planning and management practices. Protection from grazing damage, thinnings at the proper intervals, and cutting at financial maturity in such a way as to secure reproduction would be required. All-age forests in bottomlands require kinds of treatment similar to those recommended for all-age forests in the uplands.

Upland Forests

Apart from the river bottoms, corn belt woodlands are predominantly of the oak-hickory type. Management on an all-age basis seems to be indicated. If these areas are to become productive, profitable forests, certain steps must be taken to remedy their present depleted condition.

The elimination of cull trees would be a big step in the right direction. Culls occupy a substantial part of the growing space. If they were replaced by good trees, production of valuable wood might be increased as much as 60 percent. Wood from culls can be sold for fuel or pulpwood. Large, limby culls which are not practical to fell and split can be girdled and left standing.

All woodlands should be protected from grazing damage. Very lightly-stocked areas and seedling and sapling stands especially need this protection if forest conditions are to be maintained.

Where salable, thinnings should be made in heavy pole stands to stimulate growth. On the other hand, some areas will require planting if it is desired to restore them quickly to full productivity.

The Real Objective

Application of the above-listed practices, i.e., improvement cuttings, thinning, and planting where necessary, will usually lead to the establishment of a thrifty, vigorous growing stock. Some stands, particularly those with a high concentration of trees in pole sizes, will approach this condition rather rapidly with proper treatment. Others, depending upon the degree of their depletion, will need more time. Once the thrifty growing stock is established, it will result in a greater annual increment of high-quality wood and probably a greater annual income for the owner. The harvest can then be regulated to serve the two purposes of providing an adequate return for the owner's labor and investment and a continuing source of timber products.

A continuing good market for forest products in the region seems assured. A considerable volume of high-quality harvest and a thrifty growing stock should attract more diversified and efficient processing plants. These in turn should make possible the manufacture of higher quality products and should provide a higher return to the timber grower.

Most owners will require some technical advice and assistance for a program of woodland rehabilitation. State district, farm, and extension foresters throughout the area are in a position to provide this assistance. In addition, at least one woodland owners' cooperative, which employs a private forester, is now operating in the valley of the Illinois River. The objective of both government and private agencies is the same: to stabilize the forest business at the highest point of economic return consistent with sustained yield and proper protection of the land.

Recommendations

The owner of wooded land should decide whether the ultimate use is to be woodland or another use. If he decides in favor of woodland, he should take such reasonable steps as may be needed to make it fully productive. To this end, he should:

1. Clean out the cull trees, to provide room for better growing stock.
2. Make thinnings in dense pole stands.
3. Plant deforested areas which will not reseed naturally.
4. Protect all stands from grazing damage.
5. Plan harvest cuts so as to maintain a healthy growing stock of proper sizes and in proper numbers.
6. Obtain technical assistance where needed to plan and carry out this program.

RESEARCH TERRITORY

OF THE

CENTRAL STATES FOREST EXPERIMENT STATION

FOREST SERVICE

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